

WHAT IS CLAIMED IS:

1           1.     An optical waveguide connecting structure in which  
2     core layers are connected to make an optical coupling therebetween  
3     by using a plurality of optical waveguide films each having said  
4     core layers covered with a clad layer on the periphery thereof,  
5     said core layers functioning as an optical waveguide, comprising:  
6           a first optical waveguide provided with a first core layer,  
7     in which a first section slightly slants relative to an optical  
8     path direction of said first core layer is set to form a small  
9     angle of approximately 5 degrees or less with said optical path  
10    direction and said first core layer is exposed in said first  
11    section; and  
12           a second optical waveguide provided with a second core layer,  
13    in which said second core layer is exposed at one end portion  
14    thereof in a section forming an angle of approximately 5 degrees  
15    or less with said optical path direction,  
16           wherein said first section and said second section are  
17    opposed and connected to each other while setting both of s said  
18    first core layer and the second core layer at approximately a same  
19    height from a common reference surface.

1           2.     The optical waveguide connecting structure according  
2     to claim 1, wherein at least one of said first optical waveguide  
3     and said second optical waveguide is formed of an optical  
4     waveguide film.

1           3.     The optical waveguide connecting structure according  
2     to claim 1, wherein each of said first section of said first optical

3 waveguide and said second section of said second optical waveguide  
4 is formed of a section vertical to a surface of said first optical  
5 waveguide.

1 4. The optical waveguide connecting structure according  
2 to claim 1, wherein each of said first section of said first optical  
3 waveguide and said second section of said second optical waveguide  
4 is formed of a slant surface relative to a vertical direction to  
5 a surface of said first optical waveguide.

1 5. The optical waveguide connecting structure according  
2 to claim 1, wherein said second optical waveguide includes a  
3 mirror surface, which is formed of a third section cut obliquely  
4 relative to a thickness direction, at an other end portion at an  
5 opposite side of said one end portion of said second core layer.

1 6. The optical waveguide connecting structure according  
2 to claim 1, wherein said first optical waveguide and said second  
3 optical waveguide are formed on a base substrate.

1 7. The optical waveguide connecting structure according  
2 to claim 1, wherein said first optical waveguide is formed on a  
3 base substrate, said second optical waveguide is formed on a  
4 reference plate, and said core layer of said second optical  
5 waveguide is aligned with said core layer of said first optical  
6 waveguide at a same height from said reference plate as said  
7 reference surface by abutting said first optical waveguide to said  
8 reference plate.

1           8.     The optical waveguide connecting structure according  
2 to claim 1, wherein said first optical waveguide is cut to expose  
3 a side surface of said first core layer in a section along said  
4 optical path direction from said one end portion to said other  
5 end portion.

1           9.     The optical waveguide connecting structure according  
2 to claim 1, further comprising:

3           a third optical waveguide having a third core layer formed  
4 thereon and a mirror surface formed on said third core layer by  
5 cutting said third core layer obliquely relative to a thickness  
6 direction at an other end portion, said third core layer being  
7 partially exposed at a position opposed to an exposed surface of  
8 said first core layer in a side surface of said one end portion,  
9 being extended having a specified angle relative to said exposed  
10 surface of said first core layer from said exposed portion to a  
11 halfway portion, and being extended in parallel to said exposed  
12 surface of said first core layer from said halfway portion to said  
13 other end portion,

14           wherein said first core layer and said third core layer are  
15 connected at approximately a same height position while  
16 maintaining a relation that said mirror surface of said third core  
17 layer and a mirror surface of said second core layer are arranged  
18 to be opposed to each other.

1           10.    The optical waveguide connecting structure according  
2 to claim 1, wherein at least one of said second core layer and  
3 said third core layer is adhered to said first core layer by an  
4 adhesive having approximately a same refractive index as those

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5 of said first core layer to said third core layer.

1 11. The optical waveguide connecting structure according  
2 to claim 1, wherein two said first optical waveguides are used  
3 to be arranged on a base substrate such that said optical path  
4 directions thereof form a specified angle, said second optical  
5 waveguide is provided, which has said second sections at said both  
6 end portions of said core layer thereof, said second sections  
7 being opposed to said first sections of two said first optical  
8 waveguides, and said core layer of said second optical waveguide  
9 forms a curved-shape to change said optical path direction by a  
10 specific angle.

1 12. The optical waveguide connecting structure according  
2 to claim 11, wherein, instead of said second optical waveguide,  
3 an optical waveguide is used, in which a mirror surface for totally  
4 reflecting optical signals is formed at a halfway position of said  
5 core layer functioning as said optical waveguide by which said  
6 optical signals are made incident and emitted.

1 13. An optical element mounting structure assembled by  
2 using an optical waveguide connecting structure, comprising:  
3 an optical waveguide connecting structure in which core  
4 layers are connected to make an optical coupling therebetween by  
5 using a plurality of optical waveguide films each having said core  
6 layers covered with a clad layer on the periphery thereof, said  
7 core layers functioning as an optical waveguide, including: a  
8 first optical waveguide provided with a first core layer, in which  
9 a first section slightly slants relative to an optical path

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10 direction of said first core layer is set to form a small angle  
11 of approximately 5 degrees or less with said optical path  
12 direction and said first core layer is exposed in said first  
13 section; and a second optical waveguide provided with a second  
14 core layer, in which said second core layer is exposed at one end  
15 portion thereof in a section forming an angle of approximately  
16 5 degrees or less with said optical path direction, wherein said  
17 first section and said second section are opposed and connected  
18 to each other while setting both of s said first core layer and  
19 the second core layer at approximately a same height from a common  
20 reference surface; and wherein said second optical waveguide  
21 includes a mirror surface, which is formed of a third section cut  
22 obliquely relative to a thickness direction, at an other end  
23 portion at an opposite side of said one end portion of said second  
24 core layer; and

25 an optical element substrate having an optical element  
26 connected thereto,

27 wherein said optical element substrate is disposed such  
28 that said optical element is opposed to said mirror surface of  
29 said second core layer of said third section of said second optical  
30 waveguide.

1 14. An optical element mounting structure, comprising:  
2 a base substrate having a first optical waveguide disposed  
3 thereon; and

4 an optical element substrate, on which at least a second  
5 optical waveguide is disposed via a spacer and an optical element  
6 is mounted,

7 wherein core layers of said first optical waveguide and said

8 second optical waveguide are exposed in sections each forming a  
 9 slight angle of approximately 5 degrees or less with optical paths  
 10 of said core layers, and

11 said base substrate and said optical element substrate are  
 12 combined by abutting said first optical waveguide to a surface  
 13 of said spacer of said optical element substrate as a reference  
 14 surface such that said sections of said core layers are opposed  
 15 to each other at a same height from said base substrate.

1 15. An optical element mounting structure, comprising:  
 2 a base substrate having a first optical waveguide disposed  
 3 thereon; and

4 an optical element substrate, on which at least a second  
 5 optical waveguide is disposed via a spacer and an optical element  
 6 is mounted,

7 wherein core layers of said first optical waveguide and said  
 8 second optical waveguide are exposed in sections each forming a  
 9 slight angle of approximately 5 degrees or less with optical paths  
 10 of said core layers, and

11 said base substrate and said optical element substrate are  
 12 combined by abutting said second optical waveguide to a surface  
 13 of said base substrate as a reference surface such that said  
 14 sections of said core layers are opposed to each other at a same  
 15 height from said base substrate.

1 16. An optical element mounting structure, comprising:  
 2 a first optical waveguide film, in which a section of a core  
 3 layer is exposed at one end portion thereof and an other end portion  
 4 of said core layer exposed in a first section forming a slight

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5 angle of about 5 degrees or less with optical paths of said core  
6 layers at said other end portion of said first optical waveguide  
7 film;

8 an optical element of which any one of a light-emitting  
9 window and a light-receiving window of said optical element is  
10 connected to said section of said core layer of said first optical  
11 waveguide to form a combined body with said first optical  
12 waveguide film; and

13 a second optical waveguide film, in which a core layer at  
14 least at one end portion thereof is exposed in a second section  
15 forming a slight angle of 5 degrees or less with said optical path,

16 wherein both said first optical waveguide film and said  
17 second optical waveguide film are placed on a base substrate and  
18 said core layer exposed in said first section and said core layer  
19 exposed in said second section are aligned at a same height by  
20 using said base substrate as a reference surface and are adhered  
21 to each other.

1 17. An optical element mounting structure, comprising:  
2 a first optical waveguide film, in which a section slants  
3 relative to a film surface is formed at one end portion, a core  
4 layer of a first optical waveguide is exposed in said section,  
5 and at an other end portion of said first optical waveguide film,  
6 said other end portion of said core layer is exposed in a first  
7 section forming a slight angle of approximately 5 degrees or less  
8 with optical paths of said core layers;

9 an optical element connected to a surface of said first  
10 optical waveguide film at a position to which optical signals of  
11 said first optical waveguide totally reflected at said section

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12 are reached,

13 a second optical waveguide film, in which at least one end  
14 portion of a core layer is exposed in a second section forming  
15 a slight angle of approximately 5 degrees or less with said optical  
16 path,

17 wherein both said first optical waveguide film and said  
18 second optical waveguide film are placed on a base substrate and  
19 said core layer exposed in said first section and said core layer  
20 exposed in said second section are aligned at a same height from  
21 said base substrate and are adhered to each other.

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1 18. An optical element mounting structure, comprising:  
2 a printed circuit board, in which a first optical waveguide  
3 having a core layer connected to an optical element at one end  
4 portion thereof is disposed on a base substrate, and an other end  
5 portion of said core layer of said first optical waveguide is  
6 exposed in a first section forming an angle of approximately 5  
7 degrees or less with an optical path direction of said core layer;  
8 and

9 a second optical waveguide film on said base substrate,  
10 having a core layer exposed in a second section forming a slight  
11 angle of approximately 5 degrees or less with said optical path  
12 in one end portion thereof,

13 wherein one end of said second optical waveguide film is  
14 placed on said base substrate of said printed circuit board while  
15 setting said height of said core layer from said base substrate  
16 approximately equal to that of said core layer of said first  
17 optical waveguide, and

18 said core layer exposed in said second section of said



19 second optical waveguide film and said core layer exposed in said  
20 first section of said printed circuit board are in contact with  
21 each other.

1 19. The optical element mounting structure according to  
2 claim 18, wherein a reference plate covering a joint portion of  
3 said second optical waveguide film and said first optical  
4 waveguide is adhered onto said second optical waveguide film, and  
5 said height of said core layer of said second optical waveguide  
6 film is set equal to that of said core layer of said first optical  
7 waveguide by abutting said first optical waveguide to a surface  
8 of said reference plate.

1 20. The optical element mounting structure according to  
2 claim 18, wherein said second optical waveguide film has a portion  
3 in which a width of said optical waveguide inside said second  
4 optical waveguide film is widened in a shape of a taper and a  
5 portion in which a space portion so as to cross said optical path  
6 of said core layer at said portion widened in said shape of taper  
7 is formed, said portion being for connecting the widened core  
8 layers with interposing said space portion therebetween, and  
9 said space portion is formed to have a curved shape in which  
10 a width of the space in the direction of said optical path is  
11 widened as getting away from an optical axis of said core layer  
12 in a vertical direction.

1 21. An optical fiber mounting structure, comprising:  
2 a first optical waveguide film, in which, a fourth section  
3 slightly slants at approximately 5 degrees or less relative to

4 a film surface thereof is formed at one end portion, one end portion  
5 of a core layer is exposed in said fourth section, a first section  
6 is formed at an other portion of said core layer, said first section  
7 being approximately vertical to said film surface of said first  
8 optical waveguide film and forming an angle of approximately 5  
9 degrees or less with an optical path direction of said core layer;

10 an optical fiber having a section cut at an angle of  
11 approximately 5 degrees or less respective to a core layer  
12 direction, said optical fiber being connected to said fourth  
13 section of said first optical waveguide film by aligning said core  
14 layers thereof; and

15 a second optical waveguide film in which at least one end  
16 portion of said core layer is exposed in a second section vertical  
17 to said film surface and slightly slants at approximately 5  
18 degrees or less relative to said optical path,

19 wherein both of said first optical waveguide film and said  
20 second optical waveguide film are placed on a base substrate and  
21 a height from said base substrate of said core layer exposed in  
22 said first section and that of said core layer exposed in said  
23 second section are set equal and adhered to each other.

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